

CLAIMS

What is claimed is:

1. A magnetic device for manipulating magnetic particles in a fluid sample comprising,  
an electromagnet disposed within a ferromagnetic tip, the ferromagnetic tip being disposed at an end of a rod and configured to fit within internal dimensions of a fluid sample well; and  
conductive leads configured for connecting the electromagnet to a current supply.
2. The magnetic device of claim 1 further including a removable tip sheath that engages the tip, and wherein the tip sheath is configured to fit within the internal dimensions of the fluid sample well.
3. The magnetic device of claim 2, wherein the tip sheath is comprised of a non-ferromagnetic plastic material that permits transmission of magnetic flux through the sheath.
4. The magnetic device of claim 1 further including a second conductive lead configured to impart an electrical polarity to the tip when connected to a power supply.
5. The magnetic device of claim 4, further including an electrical control module configured to switch electrical power on an off to at least one of the electromagnet and the tip.
6. A system including the magnetic device of claim 1, and further including a second electromagnet spaced apart from the magnetic device of claim 1 across a volume of the fluid sample, and including a control module configured to alternately supply power to either the magnetic device of claim 1 or the second electromagnet.

7. A magnetic device for manipulating magnetic particles in a fluid sample, comprising,

a rod comprised of a ferromagnetic material having an upper portion and a lower portion, the lower portion terminating at a tip configured to fit within internal dimensions of a fluid sample well,

a conductive coil formed around the upper portion of the rod to form an electromagnet assembly; and

leads for connecting the conductive coil to a current source.

8. The magnetic device of claim 7 wherein the tip has a first cross section with a first perimeter greater than a second perimeter of a second cross section of the upper portion of the rod.

9. The magnetic device of claim 7 further including a removable tip sheath that engages an outer contour of the tip, and wherein the tip sheath is configured to fit within the internal dimensions of the fluid sample well.

10. The magnetic device of claim 9, wherein the tip sheath is comprised of a non-ferromagnetic plastic material that permits transmission of magnetic flux through the sheath.

11. The magnetic device of claim 7 further including a second conductive lead configured to impart an electrical polarity to the tip when connected to a power supply.

12. The magnetic device of claim 11, further including an electrical control module configured to switch electrical power on and off to at least one of the electrode and the electromagnet.

13. A system comprising the magnetic device of claim 7, and further comprising a second electromagnet spaced apart from the magnetic device of claim 7 thereby defining a volume between the second electromagnet and the magnetic

device of claim 1, and including a control module configured to alternately supply power to the magnetic device of claim 1 or the second electromagnet.

14. A system for manipulating ferro-magnetic particles in a fluid sample well comprising,

an electromagnetic rod assembly comprised of a ferromagnetic material dimensioned as a rod having an upper portion and a lower portion, the lower portion terminating in a tip configured to fit within internal dimensions of a fluid sample well;

conductive leads configured for connecting the electromagnet to a current supply; and

an actuator assembly interconnected with the electromagnetic rod assembly and configured to move the rod assembly in at least one of a vertical and a horizontal direction.

15. The system of claim 14 wherein the actuator assembly is configured to independently move the rod in each of the vertical and horizontal directions.

16. The system of claim 14 further including an array of fluid sample wells positioned below the electromagnetic rod assembly and wherein the actuator assembly is configured to independently move the electromagnetic rod assembly in the vertical direction within the fluid sample wells, and in the horizontal direction between different sample wells in the array.

17. The system of claim 14 further including an electrical control assembly configured to alternatively turn on and turn off current supplied to the electromagnet rod assembly.

18. The system of claim 14, further including a removable tip sheath that engages an outer contour of the tip, and wherein the tip sheath is configured to fit within the internal dimensions of the fluid sample well

19. A method for manipulating magnetic particles in a fluid sample, comprising

contacting a fluid sample containing the magnetic particles suspended therein, with an electromagnetic rod assembly comprised of a ferromagnetic material dimensioned as a rod having an upper portion and a lower portion, the lower portion terminating in a tip configured to fit within internal dimensions of a fluid sample well; and

alternately switching the electromagnet rod assembly on and off to alternatively engage and disengage the magnetic particles with at least one of the tip, or a tip cover comprised of a non-ferromagnetic material that engages the tip.

20. The method of claim 19, wherein the electromagnetic rod assembly or tip sheath engages the magnet particles in a first sample well and disengages the magnetic particles in a second sample well different from the first.